

sent condition of things did not exist, or, existing, was not known. It might possibly be thought advisable to place a limit on the capacity of cess-pits, even for their legitimate purposes, by fixing a relation between the level of the adjacent ground and buildings and that of the contents, and attaching a penalty to the filling of a pit beyond that limit. But my concern with the legislative and engineering relations of this difficult subject is limited to investigating and expounding the chemical and physiological conditions which the legislator and engineer must keep in view.

I have the satisfaction to conclude this portion of my subject by intimating that both flushing and filtration of sewage have now been stopped in every known instance; and I have the pleasure to know that my conclusions were favourably received by high scientific authorities in England.

# ART. LV.—*Air and Water Poisoning in Melbourne.*

By SYDNEY GIBBONS.

[Read 13th December, 1869.]

## PART II.

### ON THE POSSIBLE POLLUTION OF THE YAN YEAN RESERVOIR BY THE DRAINAGE OF WHITTLESEA.

Let me now recur for a few moments to the observations recorded under Case VII., on the Yan Yeau water, which for convenience I here repeat:—

“*Case VII. Yan Yeau water from service, clean and sweet.*—Very minute bright green deposit on long standing; the water being then quite bright. A sufficient quantity of the deposit for microscopic examination was obtained by allowing successive portions of the water to subside in a large conical glass.

“Solid residue (total per gallon) . . . 8·736 grains.

“Organic volatile matter, do. . . . 2·152 „

“Inorganic do., do. . . . . 6·584 „

“(The separation of the inorganic matters did not concern the question then in hand, nor is it connected with the present inquiry.)

"No ammonia, nitrates or sulphuretted hydrogen were found.

"The suspended organic matter, as shown on microscopic examination, consisted entirely of those plants and animals which live in pure water only, viz. :—

"Monads.

"Rotifers.

"Desmids—*Micrasterias*, *furcata* and *pinnatifida*, *Stancistrum*, *gracile*, *paradoxum*, and *orbiculare*, *Arthrodesmus incus*, *docidium* (?) *truncatum*.

"There were no fungi or confervæ of any kind, and the absence of all animalcules of the kolpod group was also marked."

See Plate I., opposite page.

I have on other occasions found other organisms ; but the general observation as to their character has always held good.

The recent report of the City health-officer, and the comments of Dr. Richardson, have made this analysis important evidence in a direction not before contemplated. Nearly three months since, Mr. Girdlestone, having a suspicion that there was at least a risk of the Yan Yean reservoir receiving the drainage from Whittlesea township, even if it had not already done so, determined on investigating the matter himself, and invited Dr. Richardson and myself to accompany him, and to assist in the inspection. At first I hesitated to make any deliverance on the subject, from a motive of delicacy, considering it as his case, and even when Dr. Richardson's paper appeared, I determined to let them enjoy all the κῶδος ; but now that they have been stigmatized as alarmists, and the proceeding treated in some quarters with mixed slight and derision, I think it only fair to take my share of the responsibility, especially as I may be able to throw a little light on the matter from a direction not hitherto considered.

I examined the water while investigating the subject of sewage, &c., in order to satisfy myself and the Health Committee that the noxious matters detected in the other cases cited proceeded entirely from the suspected sources. With my own knowledge of the Yan Yean water, which I have so repeatedly had occasion to analyse I regarded this examination as little more than a necessary formality, but I am now very glad that I made it. My friend Mr. Johnson has lately published an analysis of the water, which agrees

pretty exactly with that given above ; the differences being less than I have myself found to occur between samples of my own taken at different times. But Mr. Johnson's report, as published, does not give us the precise information we now require. The determinations given afford us no idea of the presence or absence of the noxious products of decomposition, nor of the nature, physical or chemical, of the organic matter. These all-important particulars I now endeavour to supply ; and, although many of the experiments were made more than twelve months since, they are still significant.

Now it must be conceded that, as Mr. Johnson argues, a dead bullock or so would bear a very small proportion to the large volume of water in the reservoir, and the cold infusion of the beef and its products would not of necessity be detectable by the unaided senses, or even, perhaps, by the ordinary chemical tests. And I can hardly help thinking that this rather detracts from the sedative effect which his report might otherwise have on our minds after Mr. Girdlestone's revelation.

But there are chemical methods which are pursued when the senses cease to give any indication, and when even the processes in common use fail ; and these methods, or some of them, are specially used in cases of this kind, and are found to give satisfactory indications that cannot be obtained in any other way. They are tedious and operose, but leave taste and smell, lead solutions and platinum salts, far behind. Beside these delicate chemical processes, the microscope furnishes evidence of a very remarkable character. Certain organisms, animal and vegetal, inhabit water of different kinds, and containing different kinds of matter in solution or suspension. I have in the former division of this paper referred to some of these. If any matter is introduced which is unfavourable to any of these organisms, they die out and are replaced by others. In some of these cases the change may be metamorphic, in others total substitution by the introduction or development of other germs. Such changes are familiar to those who interest themselves in this branch of science, and have been often observed by myself.

"It may be a law of Nature," says Kenrick,\* "that the altered condition of the elements shall be slowly followed

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\* *Primæval History.*

by changes of organs and structure which at length amount to specific or even generic differences ; . . . to bring into being new races, whenever the earth, in its progress from its primæval to its present state, was prepared to receive them. On either supposition, the correspondence between the world and its inhabitants, at any given period, is the result of adaptation."

And the observation is of equal weight when applied to our aquatic microcosm.

Now, the organisms found by me in the Yan Yean water on the occasion noted, and on others when I have subjected it to microscopic analysis, were uniformly those which prefer sweet pure water, and most, if not all, of them were such as would disappear with greater or less rapidity on the contamination of the water by decomposing animal matters or refuse ; by such matters, I mean, as contain nitrogen, especially in albuminoid compounds, or sulphur, either unoxidised or in a low state of oxidation. The other examinations recorded above show that these same organisms did actually die out of this same water on the addition of very small quantities of such noxious matter. Consider, for example, the case of the Lying-in Hospital (Case III.), when the Yan Yean was running through it, full bore, by day and night ; so that the contents of the cesspit itself were nearly inodorous in the bulk, and only became offensive after having been bottled for some weeks, then of course they were bad enough, simply because the matters which had not reached the putrefactive stage when the sample was taken attained it in the bottles without further dilution or change of liquid. To me this part of the investigation was of extreme interest, and you may judge from the number of species determined then, I spared no pains to make the evidence complete.

I shall now be asked how I build on these observations a diagnosis on the subject of the alleged contamination of the Yan Yean.

I have conceded to Mr. Johnson that a drowned bullock or two would not produce any very marked effect, and might escape notice altogether unless an analyst suspected it, and laid himself out accordingly. I have pronounced that up to a recent period no such contamination was detectable in the water, even by specially devised means ; nay, farther, that the microscopic evidences are almost incompatible with its existence ; and yet I now take part with those gentlemen who have announced that the Whittlesea drainage falls

toward the Reservoir, and now tell all who are interested—as who is not?—that if active measures are not soon taken to remedy the evil, our water supply, now so pure and sweet, will one day become a poison. When the time comes—it may not be in our day (we shall poison our children, but may escape ourselves)—the evil will be past remedy.

I fancy that I can advance these propositions with a tolerably good grace, as from the opening of the supply I have been an advocate of the Yan Yean. I battled for it when all I got for my pains was ungenerous detraction from some, and silly banter from others, because I knew it to be good. I analysed it many times; visited the place myself; sampled private taps, public hydrants, and the reservoir itself. It was always wholesome. It had no inherent fault the removal of which would not have been of doubtful policy even if it had been practicable. I always maintained that it would go on improving; and to show concisely some of this improvement that has already taken place, I append, side by side, an analysis of my own in 1858, the best of several made in that year, and that lately published by Mr. Johnson.

	Gibbons, 1858.	Gibbons, 1868.	Johnson, 1869.
Organic matter . . .	2.82	2.152	1.65
Soluble Salts . . .	3.56	} 6.584	4.45
Earthy compounds . .	1.22		} 2.20
Silica . . .	2.12		
Iron and Alumina . .	2.14		
Total Residue . .	11.86	8.736	8.30

I have not perhaps yet sufficiently shown what I mean by the apparent paradox when I say that the water is pure now, or was but lately, that it is exposed to contamination, and that in time there will be little chance of a remedy. If it were merely that the reservoir was getting saturated, there might be hope, for the worse it got in that way the sooner fallow, fresh air, and sunlight would purify it. But if my former remarks on the soakage of sewage have received attention, my meaning will become plain. It is this—That Whittlesea drainage is “going” to the reservoir there is no room to doubt. It may be disputed, that goes for nothing. Messrs. Girdlestone and Richardson



have already announced it to the Civic authorities and to the Medical Profession, and the journals have transmitted the information to the public.

I now place on the records of this Society, briefly, that we tracked the drains of Whittlesea, such as they are, house, land and swamp, till we found ourselves at the inlet sluice of the reservoir; we then started back, and ran up all the creeks and gullies one by one, and found them to rise in Whittlesea or the surrounding homesteads and pasturages. I was surprised, and by no means well pleased, to find my favorite Yan Yean endangered by such evil communications.

I believe the real state of the case to be this: Whittlesea drainage is literally "going" to the Yan Yean reservoir. But only literally, it has not gone into it yet, or, if at all, only lately to an unappreciable extent and under the least injurious conditions, as in flood. Happily swamps and flat country with much porous soil intervene. This land is gradually soaking up the filth discharged upon it. When it is saturated it will be a never failing source of water poison, and those who are then living may have to abandon the costly and splendid work whence we now derive that invaluable blessing, a copious supply of good wholesome water. The remedy must be applied now, if ever.

More than eleven years ago I offered, in a voluminous report which I was called on to prepare for the Commission of Water Supply, some suggestions for the improvement and preservation of the water. One of them, a plan for clearing off the suspended impurities which were an unavoidable accident of a newly opened work, was promptly adopted with satisfactory results; and another, for stocking the reservoir with fish, frogs, and snails, at a time when the quidnuncs were crying out against the water because it already contained living beings, was I believe acted on, though not to the extent that I desired.

The effect of another suggestion made at the same time will be judged of when I quote it. The report already cited concludes with these words:

*"I sincerely hope that the Government will not, for the sake of a small present return in the shape of land sales, sanction so great a prospective and irremediable evil as the formation of townships on, or even near, the banks of the reservoir."*

I have spoken strongly because I feel earnestly that the several evils which I demonstrate are fraught with danger,

and that the difficulty of removing them increases with delay so rapidly, that there is risk of its becoming one day insurmountable if now neglected. The frequent use of the first person was difficult to avoid under the circumstances—it is not egoism.

*Note.*—I avail myself of the scanty leisure which I have had since the adjournment of this paper, to offer some additional notes.

Some of our writers have anticipated and misunderstood the object of the paper, and have supposed from the fact that the water has lately been in bad order, that it was going to be denounced as containing a direful amount of filth. For some time past the water of the Yan Yean has been a high and certainly not attractive colour, and has been more or less turbid. This condition has no necessary connection with the question above discussed. It was observable when the supply was newly opened, and from very similar causes. We have had a season of drought, the contents of the reservoir were reduced far below the mean level, and subsequent heavy rains have stirred up the bottom, and diffused flocculent debris through the whole bulk of the liquid, which debris being only slightly heavier than the water does not quickly subside. Moreover, the floods carried with them into the reservoir a large amount of peaty matter in solution, as well as other substances in suspension. But during the past month's comparative quiescence the water has regained much of its original character; its colour is now much better; it cleans itself much more rapidly; and the spontaneous precipitate is not only much smaller, but is recovering its colour, the healthy green tint before alluded to being now noticeable. I hope to illustrate this part of the subject on a future occasion. The minute vegetal organisms (*Desmidiæ*) are illustrated by the photograph, fig. 5.

I regret to have seen advertisements setting forth as commendatory of certain filters that the Yan Yean contained some objectionable substances mentioned by name, and that the filters in question, and those only, would remove them. I know nothing of the firm so advertising, and am quite willing to assume that its filters are very good, but I deem it right in the public interest to declare that the noxious substances mentioned do not and never did exist in the water, and that if they did exist, no filter would remove them. It is not the function of a filter to remove matters

in solution, and no filter as such will do so. And I protest here, as I have often done before, against the practice of raising bugbears to frighten the public unnecessarily. There is quite enough to find fault with, and quite enough to guard against, without resorting to sensational fictions. I might say more, but as I only wish to condemn the practice, without assuming the position of antagonism toward any individuals, this brief reference to the subject must suffice.